

MONTHLY WEATHER REVIEW.

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INTRODUCTION.

The MONTHLY WEATHER REVIEW for July, 1904, is based on data from about 3300 stations, classified as follows:

Weather Bureau stations, regular, telegraph, and mail, 167; West Indian Service, cable and mail, 4; River and Flood Service, regular 43, special river and rainfall, 190, special rainfall only, 56; voluntary observers, domestic and foreign, 2565; total Weather Bureau Service, 3025; Canadian Meteorological Service, by telegraph and mail, 20, by mail only, 13; Meteorological Service of the Azores, by cable, 2; Meteorological Office, London, by cable, 8; Mexican Telegraph Company, by cable, 3; Army Post Hospital reports, 18; United States Life-Saving Service, 9; Southern Pacific Company, 96; Hawaiian Meteorological Service, 75; Jamaica Weather Service, 130; Costa Rican Meteorological Service, 25; The New Panama Canal Company, 5; Central Meteorological Observatory of Mexico, 20 station summaries, also printed daily bulletins and charts, based on simultaneous observations at about 40 stations; Mexican Federal Telegraph Service, printed daily charts, based on about 30 stations.

Special acknowledgment is made of the hearty cooperation of Prof. R. F. Stupart, Director of the Meteorological Service of the Dominion of Canada; Mr. R. C. Lydecker, Territorial Meteorologist, Honolulu, Hawaii; Señor Manuel E. Pastrana, Director of the Central Meteorological and Magnetic Observatory of Mexico; Camilo A. Gonzales, Director-General of Mexican Telegraphs; Capt. S. I. Kimball, Superintendent of the United States Life-Saving Service; Lieut. Commander H. M. Hodges, Hydrographer, United States Navy; H. Pit-

tier, Director of the Physico-Geographic Institute, San José, Costa Rica; Commandant Francisco S. Chaves, Director of the Meteorological Service of the Azores, Ponta Delgada, St. Michaels, Azores; W. N. Shaw, Esq., Secretary, Meteorological Office, London; Rev. José Algué, S. J., Director, Philippine Weather Service; and H. H. Cousins, Chemist, in charge of the Jamaica Weather Office; Señor Enrique A. Del Monte, Director of the Meteorological Service of the Republic of Cuba.

Attention is called to the fact that the clocks and self-registers at regular Weather Bureau stations are all set to seventy-fifth meridian or eastern standard time, which is exactly five hours behind Greenwich time; as far as practicable, only this standard of time is used in the text of the REVIEW, since all Weather Bureau observations are required to be taken and recorded by it. The standards used by the public in the United States and Canada and by the voluntary observers are believed to conform generally to the modern international system of standard meridians, one hour apart, beginning with Greenwich. The Hawaiian standard meridian is $157^{\circ} 30'$, or $10^{\text{h}} 30^{\text{m}}$ west of Greenwich. The Costa Rican standard meridian is that of San José, $5^{\text{h}} 36^{\text{m}}$ west of Greenwich. Records of miscellaneous phenomena that are reported occasionally in other standards of time by voluntary observers or newspaper correspondents are sometimes corrected to agree with the eastern standard; otherwise, the local standard is mentioned.

Barometric pressures, whether "station pressures" or "sea-level pressures," are now reduced to standard gravity, so that they express pressure in a standard system of absolute measures.

FORECASTS AND WARNINGS.

By Prof. E. B. GARRIOTT, in charge of Forecast Division.

Attending the passage over and north of Scotland of a number of disturbances of slight intensity, barometric pressures over the eastern Atlantic were subject to frequent fluctuations. In the vicinity of the Azores prevailing high pressures were broken at intervals by the passage of a disturbance far to the northward, and several disturbances of moderate strength passed from the St. Lawrence Valley over Newfoundland and the North Atlantic in high latitudes.

Over the North American Continent there was a rapid succession of shallow barometric depressions from the British Northwest Territory eastward, some of which moved south-eastward over the Missouri Valley and others passed over or north of Lake Superior toward the lower St. Lawrence Valley. No low barometric areas appeared in the Southern States, and but two slight cyclonic disturbances appeared as far south as the Ohio Valley.

The passage of the low areas referred to was attended by frequent rains east of the Rocky Mountains that prevented protracted heat spells. Early in the month heavy rains in the middle-western States caused freshets in the Kansas, lower Missouri, and Arkansas rivers. An additional contributory cause of the moderate temperatures of the month is found in the tracks of high barometer areas, which were confined to the northern part of the country.

The following communication was addressed to the Weather Bureau observer at Shreveport, La., by Mr. S. W. Kerley, Secretary of the Caddo Levee Board:

At a meeting of the Caddo Levee Board held this, the 10th day of August, I was instructed to write you and express the appreciation of the board for the very valuable service rendered the Levee District by your office, in warning the planting interests in the river valley of the danger of high water. As our district has large areas of lowlands unprotected by our levee system, such information as furnished by your office has been invaluable in the past, and especially during the recent high water, and the desire of the Levee Board is to express their appreciation for the services rendered.

WEST GULF FORECAST DISTRICT.

The month was free from disturbances except occasional thunderstorms, and no storm warnings were ordered.—*I. M. Cline, District Forecaster.*

NORTH-CENTRAL FORECAST DISTRICT.

No severe storms occurred during the month, although several disturbances that crossed the Lake region were attended by more or less severe thundersqualls.—*F. J. Walz, District Forecaster and Inspector.*

ROCKY MOUNTAIN FORECAST DISTRICT.

The month was cool; thunderstorms were frequent with copious local rains on the middle-eastern slope and in Arizona, while in New Mexico the protracted drought was only partially relieved. No frost warnings were issued.—*F. H. Brandenburg, District Forecaster.*

SOUTH PACIFIC FORECAST DISTRICT.

The month was not marked by any unusual feature, unless the large number of thunderstorms in the mountains of south-

ern California, Arizona, and Nevada, and the high Sierra during the last decade be considered abnormal. A light rain fell at San Francisco on the morning of the 15th and was forecast on the evening map of the 14th, and was the first rain reported at San Francisco on that date during the last fifty-five years.—*A. G. McAdie, Professor and District Forecaster.*

NORTH PACIFIC FORECAST DISTRICT.

Owing to the frequency of low pressure areas in British Columbia with trough-like extensions reaching south over the eastern portion of this district, numerous thunderstorms occurred in the mountains and foothills of eastern Oregon, eastern Washington, and Idaho, while to the west of the Cascade Mountains rains were infrequent and crops suffered for lack of moisture. The rainfall attending these troughs of low pressure caused damaging floods in ravines and canyons. On the afternoon of the 16th a maximum wind velocity of 60 miles an hour from the southeast occurred at North Head, Wash., for which timely warnings were issued. During this gale the schooner *Zampa* was disabled and drifted ashore near Leadbetter Point early on the morning of the 17th.—*Edward J. Beals, District Forecaster.*

RIVERS AND FLOODS.

Although the Mississippi River fell steadily throughout the month, good average stages were maintained. The lowest stages in the Missouri River were also recorded on the last day of the month; but during the first decade there was a moderate flood over the lower portion, caused mainly by water from the Kansas River. The following report on this flood was prepared by Mr. P. Connor, in charge of the United States Weather Bureau office at Kansas City, Mo.:

Kansas City and the smaller towns near the junction of the Missouri and Kansas rivers escaped a recurrence of last year's flood, with all its disastrous consequences, by a very small margin. As it really happened, there was a flood that caused anxiety and considerable loss, but nothing in comparison with that of last year.

The losses this year were greatly diminished by the promptness and unanimity of action on the part of those interested in the flood warnings. This was in marked contrast with their conduct of last year, when they waited and watched the rising waters until it was too late to save anything.

The flood this year was simply one of a series of climaxes caused by the aggravated conditions that have obtained in this section of the West since spring opened. It covered a very brief period, came up suddenly, passed off suddenly, and was restricted to the extreme eastern portion of the Kansas River and the Missouri at and below Kansas City.

The spring and early summer months, like those of 1903, in Kansas and western Missouri, were abnormally wet. At Kansas City there was an excess of nearly 17 inches of precipitation from March 1 to July 8, the date of highest water. Fortunately for this community and interests below Kansas City, the most violent storms occurred outside the Kansas, commonly known as the Kaw, watershed. The rainfall in the Kaw Valley, while far too heavy and frequent for good farm work, was so distributed that the streams could carry it off without overflowing their banks until July 6, although twice in June rather heavy rains on successive days caused a good many of them to become almost bank full in places.

On the morning of July 4 rather heavy rains were reported throughout the Kaw Valley and northwest Missouri, with the larger streams in the Kaw Valley at ordinary stages. On the morning of July 5 only ordinary rains were reported over the same territory. There was as yet no cause for serious apprehension, but on the afternoon and the night of the 5th uniformly heavy rains fell over the greater portion of the Kaw Valley and northwest Missouri. At Kansas City the fall was 2.31 inches in eighteen hours, and it was equally heavy along the Kaw River to Topeka and along the Missouri to some distance above St. Joseph.

The great quantity of rain that fell in the basin at the junction of the Missouri and Kaw rivers had an immediate effect in raising the rivers at Kansas City, and in consequence the Missouri had risen 2.7 feet by the morning of July 6, placing it 1.1 feet above the danger line. The Kaw River rose 4 to 5 feet.

The following warning was issued on the morning of July 6:

"Heavy rains in the past twenty-four hours in this section have caused the Missouri River to go 1.1 feet above the danger line at Kansas City. The indications are that the Missouri may go 2 feet higher and the Kaw 4 to 5 feet higher by Thursday evening. In the absence of further rains the figures given express the maximum stages anticipated."

The following warnings were mailed to 22 places between Kansas City and Boonville:

"Heavy rains in past twenty-four hours caused a decided rise in the Kansas River and in the Missouri in this locality. A further rise of 2 feet in the Missouri is anticipated, which will place it at 24 feet, 3 feet above danger line. This stage, augmented by the streams below Kansas City is liable to cause damage in low places."

The Kaw River rose rapidly during the 6th, overflowing portions of Argentine and Armourdale, Kans., and the Missouri was getting into the low places in Harlem, opposite Kansas City.

On July 7 the Missouri had risen 1.3 feet by 7 a. m., and the Kaw had risen 4.2 feet by 9 a. m. Weather conditions continued in favor of rain.

The following forecast was issued:

"The Kaw River rose 4.2 feet and the Missouri 1.3 feet in past twenty-four hours. The Kaw will rise about 3 feet and the Missouri about 1.5 feet in the next thirty hours, which, in the absence of heavy rains, should be the crest of the flood. But the rain outlook is very uncertain and great caution should be exercised by all interested. The immediate outlook means that Argentine, Armourdale, Harlem, and the lowlands below Kansas City will be inundated, and will threaten the wholesale district in the west and the east bottoms."

The following message was sent to 17 places between Kansas City and Boonville, all that could be reached by telephone:

"The lowlands between Kansas City and Boonville will be overflowed by Friday night" (July 8).

During the day of July 7 Armourdale, Argentine, Harlem, and the low bottoms were gradually being flooded. But the inhabitants of those cities took warning and began moving their effects on the 6th. Those not having a second story to their buildings in which to store their belongings, moved them to higher ground. Many of the plants in the Kaw bottoms, including the packing houses, stock yards, manufacturing plants, etc., ceased operations. Water entered all the cellars in the west bottoms of Kansas City, and by evening threatened an invasion of the streets. Train service was crippled to the westward.

On July 8 the weather outlook had somewhat improved. The Missouri River at 7 a. m. was 25.2 feet; the Kaw had risen about 3 feet at the stock yards. The forecast this morning was:

"Rivers practically stationary since 4 a. m. to-day. Only slight fluctuations are anticipated, although prospective rains may raise the flood level slightly."

This information was issued before a report from Topeka that a 7 or 8-foot rise had taken place there could be proved erroneous. About 11 a. m. the statement was given out that the immediate outlook favored a slight fall to-night and Saturday (9th) in both rivers.

The local situation on this date was slightly more aggravated, but there was no distress. Business in the bottoms generally came to a standstill. The menacing aspect of a good sized flood always causes alarm and anxiety, yet in this case it was not working material damage except in the interruption to business, the cost of moving goods out of the way, etc.

On the morning of July 9 the Missouri was 24.8 feet, a fall of 0.4 foot. The fall in the Kaw was more pronounced.

The following forecast was issued:

"Both rivers will continue to fall during the next forty-eight hours, the Kaw about 4 feet and the Missouri 2 to 3 feet."

The river conditions and outlook were telephoned to 17 points between Kansas City and Boonville at noon.

On the morning of July 10 the Missouri had fallen 1.4 feet; the Kaw about twice as much. On July 11 the Missouri read 21.9 feet, a fall of 2.9 feet in forty-eight hours, about what had been anticipated.

The forecast issued on the 11th was:

"The Missouri will be within its banks Tuesday and will continue falling in the absence of heavy rains. The Kaw will be within its banks to-night and will continue falling."

On July 12 both rivers were within their banks, and the statement was issued that they would continue falling.

The flood having subsided the inhabitants of the deserted cities moved back, and the wheels of industry once more began to revolve in the west bottoms.

In this community the collective loss was so distributed that it is impossible to make an intelligent estimate. Probably 5000 persons moved their effects to places of safety, and then back again to their homes; railroad traffic was interrupted for four or five days, and roadbeds required some repairs; two temporary bridges across the Kaw were wrecked. The interruption to business and loss of time by the thousands of employees in the big manufacturing establishments, also represent a considerable sum of money.

There were no lives lost.

Between Topeka and Kansas City about one-half the bottom land was overflowed, and about forty per cent of the crops ruined.

Below Kansas City the loss was entirely to the growing crops on the lowlands, and was approximately \$400,000 between Kansas City and Boonville.

While the flood was in progress at the eastern end of the Kaw River, there was a moderate flood in the western portion, but fortunately for this community and interests below, the heavy rains were so timed that the highest stage was reached in the western overflow after the crest of the eastern one had passed Kansas City.